USAWC STRATEGY RESEARCH PROJECT

MERGING THE TRIBES: STREAMLINING DOD'S ACQUISITION OF UNMANNED AERIAL SYSTEMS

by

Lieutenant Colonel Michael J. Jordan
United States Air Force

Colonel George T. Doran
Project Adviser

U.S. Army War College
CARLISLE BARRACKS, PENNSYLVANIA 17013

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ABSTRACT

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The Office of the Secretary of Defense (OSD) recently released the Unmanned Aircraft Systems (UAS) Roadmap in an attempt to provide guidance for a "logical, systematic migration of mission capabilities to this new class of military tools". The roadmap addressed the following key questions:

1. What military requirements could potentially be filled by UAS?
2. What technologies are necessary to provide these capabilities?
3. When could these technologies become available to enable the required capabilities?

The OSD Roadmap was meant to "complement ongoing Service efforts to redefine their roles and missions for handling 21st century contingencies." Each military Service currently envisions UA systems as "integral components of their future tactical formations." This creates a huge potential for duplication of effort, disjointed command and control, airspace management issues and an overall inefficient use of limited acquisition funding.

The paper will examine the current and future capabilities of UA systems, and provide a logical framework for efficiently fielding and organizing UA systems in order to support the unique needs of the Services and the Combatant Commanders.

MERGING THE TRIBES: STREAMLINING DOD'S ACQUISITION OF UNMANNED AERIAL SYSTEMS

High over western Iraq a Predator unmanned aerial vehicle tracked a truckload of insurgents that had fired a pickup-truck-mounted .50 caliber machine gun at U.S. troops on patrol.[1] The Predator was piloted by United States Air Force Major Shannon Rogers and his crew, located halfway around the world at Nellis AFB, Nevada. After tracking the vehicle for over two hours, Major Rogers was finally given permission to destroy the vehicle:

> Just as Rogers pushed the button to let fly one of the Predator's Hellfire missiles, a car appeared and started to drive toward the pickup. His partner's job is to keep the missile locked on target or, if necessary, divert it to a place where it would cause as little damage as possible. "What do we do, sir?" the partner asked in a shaky voice. "Stay on the target and hope he drives fast," said Rogers coolly. The car passed, and the truck exploded violently when the Hellfire struck. Rogers let out a whoop and exchanged high fives with his partner.[2]

Scenarios of this type are occurring with increasing frequency as the use of unmanned aerial vehicles becomes more widespread on the battlefield. What has also become increasingly widespread is the "jointness" of the mission—Air Force Predators providing intelligence, surveillance, reconnaissance, and fire support to U.S. Army forces on the ground in Iraq and Afghanistan. The demand for Predators and similar unmanned aerial vehicles (UAV) continues to grow as fast as the capabilities of the systems themselves. Each military service envisions unmanned aerial systems as "integral components of their future tactical formations" and they have rushed to develop, acquire, and field service specific unmanned aerial systems.[3] The result is a chaotic, disjointed acquisition effort that squanders precious acquisition resources through simultaneous efforts to procure a wide array of unmanned aerial systems to perform similar missions. General John P. Jumper, former Air Force Chief of Staff, argues that "the effort has become disjointed, pulled apart by the 'tribal jealousies' among the various U.S. armed services."[4]

This paper will attempt to break down the current tribal jealousies by examining the current state of development of unmanned aerial vehicles and recommending a joint solution as the most cost effective course of action to meet the needs of the combatant commanders. It will review the history of unmanned aerial vehicles in the U.S. military and examine their growing utility on the modern battlefield. The Unmanned Aerial Systems Roadmap 2005 - 2030, the Department of Defense's (DoD) current top level directive for future development of these systems, will be examined as well as the systems currently in development by each of the services. The paper will detail why it is necessary to streamline acquisition efforts to improve

the efficiency of the acquisition effort and produce better results for commanders in the field. I will propose a concept for restructuring the current acquisition process to reduce duplication of effort, maximize the efficiency of scarce funding, and provide the best systems for the commanders on the battlefield.

History of Unmanned Aerial Systems

Advancements in computer and communication technology have accelerated the pace of unmanned aircraft development in the last decade, but UAV's have been around for almost as long as manned aircraft. During World War I, heavy British losses on the western front prompted the Royal Flying Corps to develop remotely piloted vehicles, primarily as flying bombs and ground attack weapons.[5] Similar developments occurred at the same time in the United States, as both the U.S. Army and Navy were experimenting with unmanned weapons. In 1917 Dr. Elmer A. Sperry developed a gyro-stabilization unit, which became the centerpiece of autopilot control units used in subsequent manned and unmanned aircraft.[6] The Sperry "Flying Bomb", a small unmanned aircraft built from a modified Curtiss biplane, performed the first fully automated flight on March 6, 1918.[7] The U.S. Army also developed an unmanned aircraft, designed by Charles F. Kettering with the assistance of Orville Wright. The Kettering "Bug", was designed from scratch as a cheap, easy to build, rail launched biplane with mechanical controls which were preset to nosedive the aircraft onto the target after flying a predetermined heading and distance.[8] Both the Sperry "Flying Bomb" and the Kettering "Bug" demonstrated some early success, but the end of the war and subsequent funding cuts led to the cancellation of both systems.[9] The U.S. military continued limited experiments with unmanned aircraft until the Great Depression of the 1930's resulted in massive cuts to the defense budget.[10]

The British continued to develop unmanned aircraft in the 1920's, and were the first to incorporate radio controls to allow remotely activated inputs. The British developed the Long-Range Gun with Lynx Engine (LARYNX), an extremely fast monoplane capable of launching from both warships and conventional airfields.[11] Rather than a mechanical clockwork device to activate the controls at preset intervals, the LARYNX contained a radio controlled device that could be activated or reprogrammed remotely. Twelve LARYNX were built, but poor results during live warhead testing resulted in cancellation of the program. Subsequent British efforts focused on developing unmanned aerial targets for the Royal Navy to counter the growing threat from aircraft, as demonstrated by Billy Mitchell's tests on surplus German warships.[12]

World War II spurred further development of unmanned aircraft and flying bombs by both the Axis and Allied powers. The most prominent and feared flying bomb of World War II was

the German Fiesler 103, better known by in the West as the V-1 Buzz Bomb. The V-1 was a small, pulse-jet powered drone which was programmed prior to launch to fly a predetermined altitude and direction.[13] A small propeller on the front of the aircraft provided crude distance measurement and automatically shut off fuel when the V-1 was over its designated target. Although the V-1 was slow and vulnerable to fighters and air defense artillery, it was highly effective as a terror weapon. Only 2,500 of the 10,500 launched against Great Britain reached their target area, but they caused approximately 14,665 casualties.[14]

Ironically it was another Nazi terror weapon, the V-2 rocket, which encouraged the development of Allied unmanned aircraft. Heavy aircrew losses by Allied Air Forces and the risk posed by attacking the heavily defended V-2 rocket sites spurred the Allies to begin experimenting with unmanned aircraft.[15] The Army Air Corps' Aphrodite Project converted damaged B-17 aircraft into flying bombs loaded with over 22,000 lbs of high explosives. A two man crew would fly the aircraft to an altitude of 2,000 feet and direct it toward the V-2 launch sites prior to arming the fuses and bailing out over friendly territory. [16] A second manned aircraft flying in trail assumed control of the flying bomb and flew it into the target. Cameras mounted on the flying bomb aircraft relayed television signals back to the controlling aircraft in order to provide terminal guidance. Many of the modified aircraft were shot down prior to reaching the target area or were rendered uncontrollable by anti-aircraft fire, but a few managed to impact their designated target areas. The Navy developed a similar program, known as Project Anvil, which used the naval version of the B-24 Liberator rather than the B-17.[17] Both Project Anvil and the Aphrodite Project were plagued with technical problems but met with limited success and demonstrated the potential of remotely piloted aircraft. Both projects were eventually deemed too expensive for the results obtained and were cancelled before the end of the war. [18]

The U.S. Navy developed a similar program during the Korean War by converting surplus F6F Hellcats into drones which were remotely controlled by AD-4Q Skyraiders. [19] The drones were loaded with explosives and flown by remote control into heavily defended Communist targets, again with mixed success. But the most significant development during the Korean War was the development and production of the first jet-powered target drone, the Ryan Aeronautical Company Q-2 Firebee.[20] The Firebee drone was a small, jet powered aircraft which could be remotely piloted by radio control or programmed to fly a preset course. While the Firebee did not play a significant role in the outcome of the Korean War, it proved to be an extremely reliable and versatile platform as a target drone to test air defense systems, and later versions were used in many different types of missions.[21] The Firebee drone proved so

successful and versatile that the latest versions are still in wide-spread service today, more than 50 years after the first flight tests.

In the 1960's, the U.S. Air Force converted Firebee target drones into unmanned reconnaissance aircraft for missions which had become too dangerous for manned aircraft. The 1960 downing of Francis Gary Powers U-2 over the Soviet Union initiated development of survivable unmanned drones to conduct highly sensitive reconnaissance missions over the Soviet Union and Communist China.[22] Engineers modified Firebee drones with radar-absorbing blankets and newly developed anti-radar paint to reduce their radar signature.[23] The Firebees were extremely successful throughout the Cold War and in Southeast Asia, flying over 3,400 operational surveillance missions with a survival rate of over 83 percent.[24]

The defining moment in modern UAV development occurred during the 1973 Yom Kippur War. After sustaining heavy losses to Egyptian surface to air missiles on the first day of the war, the Israelis modified their tactics and used unmanned drones to draw fire from Egyptian defenses. Rather than leading the way with manned aircraft, the Israelis sent in their unmanned drones to draw fire and mark the location of the Egyptian air defense sites.[25] Once the missile sites were identified, manned Israeli fighters followed very quickly to attack while the missile sites reloaded. The tactic proved extremely successful and allowed the Israelis to devastate the Egyptian air defenses and regain air supremacy. Another significant event during the Yom Kippur War was the first "weaponization" of an unmanned drone. Although unmanned aircraft had been used for years as flying bombs, the Israelis were able to adapt a Firebee drone to deliver weapons remotely. After locating a target through the TV lens of the drone, the Israelis successfully launched an AGM-65 Maverick missile and guided it remotely to its target.[26]

The Israelis continued to develop UAV's and used them very effectively during action against the Syrians over the Bekaa valley in 1982.[27] The success of the Israeli systems spurred other countries, including Great Britain and the United States, to emulate Israel's use of UAV's. In fact, several of the today's modern UAV's, such as Hunter and Pioneer, are direct derivatives of Israeli systems.[28] "The U.S. Navy, Marines, and Army acquired more than 20 of the Israeli produced Pioneer UAV's, which became the first small, inexpensive UAV's in the modern American military forces."[29]

In the United States, the Air Force was arguably the last military service to embrace and pursue UAV's, so the Army and Navy led the development of new technologies:

> Similar to the way the Army developed armed helicopters in the face of the 1948 Key West Agreement, the Army, Navy, and Marine Corps each pursued UAV's to support their service-unique, "organic" reconnaissance requirements.[30]

During Operation Desert Storm, Pioneer UAV's flew over 330 sorties among the three services with only one loss.[31] The Pioneer UAV provided intelligence, targeting information, artillery spotting, and battlefield damage assessment. The Air Force did not create its first UAV squadron until 1995, when it established the 11th Reconnaissance Squadron at Nellis AFB, Nevada.[32] In the last two decades, all of the military services have invested significant amounts of money to develop and expand the capabilities of unmanned systems.

Roles and Missions of Modern Unmanned Aerial Systems

Thus far the terms unmanned aerial vehicle (UAV) and unmanned aerial systems (UAS) have been used interchangeably, but there is an important difference. The term UAV refers only to the actual aircraft or airborne platform itself. The term UAS captures the system as a whole, to include the UAV and the associated ground systems required for command, control, and communication.[33] A typical system consists of at least one UAV, a payload or sensor package, data link, ground station, and associated ground support equipment. The distinction between UAV and UAS is important, since sophisticated ground stations provide the ability for the system to efficiently gather and distribute sensor information to commanders and decision makers at all levels of command and control.

Modern UAS have the ability to perform almost any mission that can be performed by manned aircraft, and in some cases they are better suited for the mission. In making the case for unmanned aircraft, the Office of the Secretary of Defense's Unmanned Aircraft Systems Roadmap 2005-2030 states that unmanned aircraft are better suited for "dull, dirty, or dangerous" missions.[34] Dull missions are long, tedious missions which may cause excessive aircrew fatigue or require a supplemental crew. Dirty missions expose aircrews to hazardous conditions or materials, such as the nuclear fallout tests of the late 1940's.[35] Dangerous missions, such as reconnaissance, suppression of enemy air defenses, and electronic attack, risk pilots lives and generally result in the highest loss rate of aircrews and aircraft. According to the UAS roadmap,

> The attributes that make the use of unmanned preferable to manned aircraft in the above three roles are, in the case of the dull, the better sustained alertness of machines over that of humans and, for the dirty and the dangerous, the lower political and human cost if the mission is lost, and greater probability that the mission will be successful. Lower downside risk and higher confidence in mission success are two strong motivators for continued expansion of unmanned aircraft systems.[36]

The U.S. military has finally embraced UAS technology, and the missions performed by these systems will continue to expand as the technology improves. Today, the U.S. military operates

"a force of over 1,200 small and 200 tactical and theater UAS supporting military operations worldwide."[37]

The U.S. Army is by far the largest user of UAS, operating over 500 small UAS and 120 tactical and theater UAS.[38] The U.S. Army relies heavily on intelligence and reconnaissance gathered by UAS and plans to make them key components of their Future Combat System (FCS). "Unmanned technologies represent a crucial part of FCS, which consists of 18 systems, a network and the individual soldier."[39] The Army envisions four classes of unmanned aerial vehicles organic to platoon, company, battalion, and brigade combat team echelons.[40] The Class I UAS will be a man-portable system weighing less than 40 lbs and will consist of two UAV's and a control unit. It is meant to provide "dedicated reconnaissance support and early warning to the smallest echelons of the Brigade Combat Team in environments not suited to larger assets."[41] The Class II system will be "vehicle-mounted, capable of taking off and landing in unimproved areas and able to provide enhanced dedicated imagery, accomplishing its mission while being cued remotely by Army personnel."[42] The Class III UAS will also be capable of taking off and landing in unimproved areas, and will be a "multifunction aerial combat support system capable of providing reconnaissance, communications relay, security/early warning, target acquisition, and designation."[43] Finally, the Class IV UAS will be able to take-off and land without a dedicated air field and will support the BCT Commander with "communications relay, long endurance persistent stare, and wide area surveillance."[44]

The U.S. Navy and Marine Corps currently operate over 170 tactical and theater level UAS.[45] Pioneer, the Marine Corps' primary UAS, was acquired from the Navy in 2002 as an interim solution until they procure their own vertical launch follow-on system.[46] The Navy is currently developing and evaluating two man-portable systems and one bungee launched close range system.[47] The Navy is also developing or testing four additional tactical and theater level UAS, including the Joint Unmanned Combat Air Vehicle.[48] In addition, the Navy is conducting the Global Hawk Maritime Demonstration Program and developing the Broad Area Maritime Surveillance UAS for "world-wide access, persistent maritime surveillance capability."[49]

The Air Force currently operates three Predator squadrons at Nellis AFB, Nevada, but recently announced plans "to spend $5.7 billion over the next five years to buy roughly 144 Predators – enough to add 12 squadrons of the robotic aircraft."[50] In addition to the Predator, the Air Force has successfully employed the Global Hawk Advanced Concept Technology Demonstrator in combat over Iraq and Afghanistan.[51] The Global Hawk carries "both an Electrical Optical and Infrared sensor and a Synthetic Aperture Radar with moving target indicator capability, allowing day/night, all-weather reconnaissance."[52] The Air Force is also

developing a larger version of the Predator, designated the Predator B, which will be able to carry a much larger payload.[53] In addition to these major systems, the Air Force is supporting the Global War on Terror with small, bungee/hand-launched UAS including Pointer, Raven, and some innovative micro systems.

Oversight of Department of Defense UAS Programs

As early as 1986 Congress was concerned about DoD's UAS procurement strategy. During hearings for the FY1987 defense budget, the Senate Appropriations Committee expressed the view that "each of the military services had too many UAV and drone programs, and encouraged DoD to strive for commonality in its programs."[54] Congress directed DoD to provide a master plan for UAV's to the House and Senate Committees on Armed Services along with the FY1988 budget request. As a minimum, the plan was to address:

> (1) Harmonization of service requirements, (2) Utilization of commonality, to the maximum extent possible, and (3) Trade-offs between manned and unmanned vehicles in order to provide for future cost savings.[55]

The UAV master plan was not submitted the following year and Congress subsequently determined that DoD "lacked focused management for UAV's" and "the services were pursuing programs and technologies that should be merged to avoid duplication and to ensure cost-effective approaches."[56] As a result, Congress eliminated service specific funding for UAS research, development, test, and evaluation and consolidated funds in a joint program administered by the Office of the Secretary of Defense.[57] In addition, FY1988 funds were "available only for the joint program and could not be obligated or expended until the Secretary of Defense submitted a master plan addressing, among other things, efforts to coordinate UAV programs and eliminate duplication."[58]

The Government Accounting Office (GAO) found significant problems with DoD's Master Plan when it was finally submitted on June 27, 1988. The GAO stated the Master Plan "did not reconcile service UAV requirements and eliminate duplicative programs in the near term."[59] In addition, the Plan allowed for starting new single-service programs without regard to commonality until fiscal year 1990, when a Joint Statement of Requirements would be completed.[60] The Master Plan also allowed further duplication of effort by excluding "lethal" UAS and "target drones" from the plan and allowing the services to continue to develop their own capabilities in these areas. Finally, the plan did not address redundancy in capabilities between manned and unmanned systems.[61]

To illustrate the level of resistance by the services, the GAO highlighted a medium range UAS in joint development for the Navy and Air Force. The Navy was responsible for UAV

development while the Air Force was responsible for payload development. But the Navy developed its own payload simultaneously to accomplish the same types of reconnaissance missions as the Air Force payload, stating "their payload would be less expensive and available sooner than the Air Force version."[62] However, the GAO discovered both payloads would enter production during the same fiscal year and the Navy had done no evaluation to determine which of the two payloads would be more cost-effective.[63]

In response to Congressional criticism, the Department of Defense established the UAV Joint Project Office in 1989 as "the single DoD organization with management responsibility for UAV programs" and designated the Navy as lead service.[64] The Joint Project Office was widely criticized for lack of progress and in 1993 DoD replaced it with the newly formed Defense Airborne Reconnaissance Office (DARO). DARO was meant to be "the primary management, oversight, and coordination office for all department wide manned and unmanned reconnaissance."[65] DARO was also criticized for its poor management approach and slow progress fielding UAV's and was dissolved in 1998. UAS development and acquisition responsibilities were then returned to the services, while the Assistant Secretary of Defense for Command, Control, Communications, and Intelligence was directed to provide oversight for the Secretary of Defense.[66]

In 2001, DoD established the Joint Unmanned Aerial Vehicles Planning Task Force in the Office of the Undersecretary of Defense for Acquisition, Technology, and Logistics. In April 2001, the Task Force published the first of three Unmanned Aerial Vehicle Roadmaps. Unfortunately, the 2001 Roadmap was not directive in nature and served only as a guideline to the services for future development. As a guiding document, the Roadmap did not "presume or seek concurrence from the services" and "did not impose any requirement on the services to program or fund any item described."[67]

GAO criticized the Roadmap for failing to present a comprehensive strategic plan to ensure that the services and DoD agencies develop systems that complemented each other, performed all required missions, and avoided duplication.[68] In addition, the mission of the Joint UAV Task Force was criticized since it was given no authority to enforce program direction and allowed the individual services to develop their own UAS without overarching DoD guidance. Service officials acknowledged they "developed service-specific planning documents to meet their own needs and operational concepts without considering those of other services or the Roadmap."[69] As a result, the individual services have been developing their own UAS without department wide guidance, increasing the risk of duplicate capabilities, higher costs, and interoperability challenges. The third and most recent version of the UAS Roadmap was

released in August of 2005, and suffers from the limitations. The 2005 Roadmap is still not directive in nature and is meant to "stimulate the planning process for U.S. military UA development," "assist DoD decision makers in developing a long-range strategy" and "guide industry in developing UA-related technology."[70] In fact, the Roadmap primarily seeks to address the following questions:

> What military requirements could potentially be filled by UA Systems? What technologies are necessary to provide these capabilities? When could these technologies become available to enable the required capabilities?[71]

Rather than providing acquisition and force structure guidance, the Roadmap serves more as a service and industry guide for development of future UAS technology.

Although the GAO was not satisfied with the 2005 UAS Roadmap, they did find that DoD had made some recent progress in attempting to streamline UAS development. The Joint Requirements Oversight Council (JROC), responsible for validating warfighter's mission needs and requirements during the acquisition process, established a UAV Special Studies Group in 1997 to ensure interoperability and commonality among the Services.[72] However, according to Joint Staff officials neither the JROC nor the UAV Task Force have issued a strategic plan for development and acquisition of future UAS.[73] Another measure put in place by the Joint Staff was the creation of the Joint Capabilities Integration and Development System (JCIDS) in 2003. The JCIDS established a "capabilities-based approach to identifying current and future gaps in our ability to carry out joint warfighting missions and functions."[74] Under the current construct, JCIDS has five Functional Capabilities Boards which have been "tasked with developing a list of capabilities needed to conduct joint operations in its respective functional area."[75] But while the JCIDS process may help develop warfighting capability, Joint Staff officials have stated that the JCIDS process will not result in an overarching architecture for UAS development. Finally, DoD established the Joint UAV Center of Excellence (COE) at Nellis AFB, which should be operational by late 2005. The COE will be an "operationally focused organization concentrating on UAV-systems technology, joint concepts, training, tactics, and procedural solutions to the warfighters' needs."[76] Although the COE is another step in the right direction, the center's operational focus will be slow to drive changes in the acquisition process and fielding of new systems.

<u>Proliferation on the Battlefield</u>

Combat commanders have increasingly relied on information provided by UAS on the battlefields of Iraq and Afghanistan, and their reliance is likely to increase in future conflicts. But the rapid proliferation of multiple classes of service unique UAS on the battlefield has already

created massive coordination and deconfliction problems for commanders. Among the problems are airspace control issues, bandwidth congestion, evolving missions, and varying capabilities which complicate the theater commander's ability to efficiently and effectively employ UAS. The Commandant of the Marine Corps, General Michael Hagee, recently described some of the UAS issues commanders have had to address on the battlefield. According to General Hagee, the growing use of UAS has crowded the airspace, and the services will need to work on improving procedures for deconfliction.[77] General Hagee stated it's "not only the physical deconfliction of airspace …but there is also deconfliction of your frequency space, which also has to be worked hard."[78] He explained that "We've brought some of these [UAV] systems on very fast, so it's not surprising we have some challenges with the management of frequency space."[79] Another challenge the General addressed is the ability to share and disseminate UAS intelligence data in a timely manner. As the services become increasingly dependant on intelligence, surveillance, and reconnaissance (ISR) information gathered by UAS, the architecture for sharing and distributing the data must improve simultaneously. Much of the data collected by UAS is time sensitive and will be useless unless the services have compatible ground stations to downlink and share information.[80]

Senior Commanders have repeatedly identified airspace control and deconfliction issues as a potentially serious problem. In fact, there have already been three collisions between small UAS and helicopters, and the airspace deconfliction issues have still not been resolved.[81] Theater airspace control measures are the responsibility of the Joint Force Commander, who normally delegates airspace control authority to the Joint Force Air Component Commander (JFACC). The JFACC is responsible for developing the overall airspace control plan and produces the airspace control order (ACO). The ACO and the corresponding air tasking order (ATO) serve as the single-source documents for integration and deconfliction of fixed wing aviation, rotary-wing aviation, and indirect fires.[82] UAS missions scheduled on the ATO must comply with procedures in the ACO, and normally operate in a specially designated restricted operating zone, which is airspace specially reserved and protected for the duration of UAS operations. But as UAS continue to proliferate and acquire new missions and capabilities, the deconfliction issues on the battlefield have become increasingly complex. The range, endurance, performance, and flexibility of UAS have constantly improved, which has allowed commanders to seek additional opportunities to exploit the full capabilities of the systems. This places additional demands for frequency and airspace deconfliction procedures. The increased complexity of airspace control measures required for deconfliction are likely to become so

complex and ponderous that airpower will lose its inherent flexibility, and manned aircraft will find it difficult to operate efficiently in such a complex environment.

As UAS become the predominant imagery collection systems across virtually every echelon of command, the need to coordinate, share, and integrate into the larger warfighting community has become painfully apparent. Due in large part to persistence, range, and improved communications capability, UAS no longer serve a single user or even a single Service. Recent combat operations have highlighted the deficiencies in several areas, including "lack of standard communications frequencies and waveforms, lack of standardized sensor products, lack of standardized data for both sensors and platform information, and lack of a common tasking system that crosses the traditional command seams."[83] The 2005 Roadmap also identifies "issues concerning training, logistics support, airspace integration, and CONOPS that could benefit from greater cross-Service interoperability."[84] Air Force officials worry that, as more UAS from every service join the battle, it will become increasingly difficult to manage and coordinate air combat operations, because each UAS comes with its own unique software and mission-control stations.[85]

Finally, as UAS capabilities increase, the services will seek to expand the roles and missions UAS are expected to perform. UAS have traditionally been used for ISR, but the weaponization of the Predator and the development of the Joint Unmanned Combat Aerial Vehicle clearly demonstrate that the role of the UAS is expanding. In fact, in 2004 the Joint Staff had each Combatant Commander rank the importance of 18 different types of missions for future UAS, to include electronic warfare, combat search and rescue, and strike.[86] While there is no doubt that the services will expect more from future UAS, the challenge will be ensuring the services do not acquire redundant capabilities or attempt to perform missions that are not included in their core competencies. For example, brigade commanders with a robust UAS capability should not seek to use the strike capability inherent in the systems to perform missions that have traditionally belonged to manned aircraft.

Recommendations

The dramatic increase in UAS capability promises to significantly increase the ability of commanders at all levels to control and influence the battlefield. However, the rapid proliferation of incompatible and redundant systems could potentially limit the ability of commanders to effectively exploit the potential of improved and increasingly lethal UAS. DoD must act soon to dramatically restructure the UAS acquisition process to ensure increasingly limited acquisition funds are used in the most efficient manner.

DoD must establish a joint acquisition office with the authority to direct joint development and acquisition of new UAS. The creation of the Joint UAV Task Force in 2001 was a step in the right direction, but without the authority to mandate service compliance, the disjointed acquisition of redundant and incompatible systems will continue. The role of the new joint acquisition office must be expanded with corresponding authority to mandate joint development and acquisition while producing a strategic plan for acquisition of future systems, rather than a Roadmap for development of new technology. The acquisition office must ensure service interests are represented while simultaneously looking for capability shortfalls and new missions to fully exploit the potential of current and future UAS. For example, the Office of the Under Secretary of Defense for Intelligence is producing an Intelligence, Surveillance, and Reconnaissance Integration Roadmap "centered around the concepts of ISR recapitalization and achievement of the emerging concept of persistent surveillance."[87] The ISR Roadmap seeks to fix low density/high demand shortfalls, potentially through the use of high endurance UAS. The UAS joint acquisition office must be engaged during this effort to shape the UAS portion of future ISR capabilities.

The UAS acquisition office must also have the ability to mandate service participation in joint development programs to meet their unique UAS requirements. Recent operational events, like the Predator mission described at the beginning of this paper, have clearly demonstrated the likelihood that UAS procured by one military service can support a broad range of users, including those from other military services. Congress recently mandated the transfer of the Joint-Unmanned Combat Air System (J-UCAS), a high performance fighter-type UAS, from the Defense Advanced Research Projects Agency to a joint service program managed by the Air Force. According to Dr. Glenn LaMartin, the Director of Defense Systems for the Office of the Under Secretary of Defense for (Acquisition, Technology, and Logistics), the consolidation of the separate Air Force and Navy demonstration programs has already invigorated the contractor teams and motivated work on a common operating system.[88]

DoD should also designate the Air Force as lead service for UAS development and acquisition. DoD's short lived attempt at designating the Navy as lead service was criticized as being unresponsive and slow to field new systems. However, recent improvements in UAS technology and the increased demand for UAS on the battlefield have ensured the fielding of highly capable UAS will receive high priority from the Air Force and the joint acquisition office. In addition, the Air Force is currently in the best position to leverage technology from existing systems such as Predator, Global Hawk, and the Air Force managed UAV Center of Excellence to improve the interoperability of new systems on the battlefield.

Finally, DoD must establish guidelines for UAS roles and missions and designate service responsibilities on the battlefield. The current proliferation of UAS on the battlefield has the potential to blur the lines between the traditional missions performed by ground and air forces. For example, the class IV FCS system envisioned by the Army will have the range and endurance to perform close air support and interdiction missions as well as surveillance. DoD should consider directing that all UAS operations on the battlefield, with the exception of small and micro man-portable systems, be released to the JFACC for tasking. This would ensure centralized control of UAS while simultaneously aiding the deconfliction of crowded airspace and frequency bandwidth. This would require substantial investment in a common information sharing architecture to allow commanders at all levels to benefit from the information collected by UAS.

Conclusion

DoD must act now to streamline the UAS acquisition process before the proliferation of redundant and incompatible systems saturates the battlespace and frequency spectrum to the point that both are unusable. The rapid maturation of UAS technology and the innovative missions performed by skilled UAS operators have clearly demonstrated the value of UAS on the future battlefield. Commanders increasingly expect and demand the speed and accuracy of information that UAS are uniquely suited to provide, and the demand will only increase as the technology continues to improve. The migration of UAS technology to unmanned ground systems is inevitable and will result in ever increasing demands on an already saturated frequency spectrum. The demands of the current and future battlefield require that DoD discard the current disjointed, chaotic UAS acquisition process and mandate a joint, synchronized, and coherent program to produce networked, compatible, and complementary formations of UAS for combat commanders.

Endnotes

[1] Sally B. Donnelly, "Long Distance Warriors," *Time,* 12 December 2005, 42.

[2] Ibid.

[3] U.S. Department of Defense, *Unmanned Aircraft Systems Roadmap, 2005-2030,* (Washington, D.C.: U.S. Department of Defense, 4 August 2005), 1.

[4] Dudney, Robert S., Where Do UAVs Go From Here?, *Air Force Magazine,* July 2005, 2.

[5] John W. R. Taylor and Kenneth Munson, eds., *Jane's Pocket Book of Remotely Piloted Vehicles: Robot Aircraft Today* (New York: Macmillan, 1977), 11.

[6] Steven M. Shaker and Alan R. Wise, *War Without Men: Robots on the Future Battlefield* (Washington, D.C.: Pergamon-Brassey's, 1988), 21.

[7] Ibid.

[8] Ibid.

[9] Ibid.

[10] Ibid., 24.

[11] Ibid.

[12] Ibid.

[13] Ibid.

[14] Ibid., 28.

[15] Lt Col Anthony J. Lazarski, "Legal Implications of the Uninhabited Combat Aerial Vehicle", *Aerospace Power Journal*, Summer 2002, Volume XVI, [Journal On-line], 76; available from http://www.airpower.maxwell.af.mil/airchronicles/apj/apj02/sum02/lazarski.html#lazarski; Internet; accessed 7 Dec 2005.

[16] Ibid.

[17] NOVA: Science Programming On Air and Online, *Spies That Fly,* available from http://www.pbs.org/wgbh/nova/spiesfly; Internet; accessed 16 December 2005.

[18] Lazarski, 76.

[19] Shaker and Wise, 30.

[20] Andreas Parch, "Directory of U.S. Military Rockets and Missiles", available from http://www.designation-systems.net/dusrm/m-34.html; Internet; accessed 7 Dec 2005.

[21] Ibid.

[22] Air Chief Marshal Sir Michael Armitage, *Unmanned Aircraft* (London: Brassey's Defence Publishers, 1988), 66.

[23] NOVA: Science Programming On Air and Online, *Spies That Fly*.

[24] Ibid.

[25] Shaker and Wise, 34.

[26] Ibid.

[27] Ibid., 36.

[28] Jim Garamone, "From the U.S. Civil War to Afghanistan: A Short History of UAV's", Defend America News, American Forces Press Service, [Journal Online]; available from http://www.defendamerica.mil/articles/apr2002/a041702a.html; Internet; accessed 17 December 2005.

[29] NOVA: Science Programming On Air and Online, *Spies That Fly.*

[30] Warren A. Trest, *Air Force Roles and Missions: A History*, (U.S. Government Printing Office, Washington D.C.) 1998, 121.

[31] Richard P. Hallion, Storm *Over Iraq: Air Power and the Gulf War* (Washington, D.C.: Smithsonian Institution Press, 1992), 312.

[32] MQ-1 Predator Unmanned Aerial Vehicle Fact Sheet, October 2005, linked from *The Air Force Homepage* at "Fact Sheets", available from http://www.af.mil/factsheets/factsheet.asp; Internet; accessed 7 Dec 2005.

[33] Dr. Glenn F. LaMartin, *Statement before the U.S. Congress, House of Representatives, Committee on Armed Services, Subcommittee on Tactical Air and Land Forces*, 9 March 2005, 2.

[34] *Unmanned Aircraft Systems Roadmap 2005 – 2030,* 1.

[35] Ibid., 2.

[36] Ibid.

[37] LaMartin, 3.

[38] Ibid.

[39] Colonel Robert Beckinger, Future Combat System White Paper, 29 September 2005, 3, linked from *The United States Army Homepage* at "Future Combat Systems", available from http://www.army.mil/fcs/; Internet; accessed 7 Dec 2005.

[40] Ibid.

[41] Ibid., 9.

[42] Ibid.

[43] Ibid., 10.

[44] Ibid.

[45] LaMartin, 3.

[46] *Unmanned Aircraft Systems Roadmap 2005 – 2030,* 5.

[47] *Navy Unmanned Aerial Vehicles Home Page,* available from http://uav.navair.navy.mil; Internet; accessed 7 December 2005.

[48] Ibid.

[49] LaMartin, 11.

[50] United States Air Force Press Release Number 090305; The Air Force Announces Plans to Expand its Current Predator Initiative, linked from *The Air Force Homepage* at http://www.af.mil/pressreleases/release.asp?storyID=123010068; Internet: accessed 7 December 2005.

[51] LaMartin, 11.

[52] *Unmanned Aircraft Systems Roadmap 2005 – 2030,* 6.

[53] LaMartin, 11.

[54] U.S. Government Accounting Office, *Unmanned Vehicles: Assessment of DOD's Unmanned Aerial Vehicle Master Plan*, Washington, D.C., 9 December 1988, 6.

[55] Ibid.

[56] Ibid.

[57] Ibid.

[58] Ibid.

[59] Ibid., 10.

[60] Ibid.

[61] Ibid.

[62] Ibid., 11.

[63] Ibid.

[64] U.S. Government Accounting Office, *Force Structure: Improved Strategic Planning Can Enhance DOD's Unmanned Aerial Vehicles Efforts*, Washington, D.C., March 2004, 7.

[65] Ibid.

[66] Ibid.

[67] U.S. Department of Defense, *Unmanned Aircraft Vehicle Roadmap, 2000-2025,* (Washington, D.C.: U.S. Department of Defense, 6 April 2001), 1.

[68] Government Accounting Office, *Force Structure: Improved Strategic Planning Can Enhance DOD's Unmanned Aerial Vehicles Efforts,* March 2004, 9.

[69] Ibid., 6.

[70] *Unmanned Aircraft Systems Roadmap 2005 – 2030,* 1.

[71] Ibid., 1.

[72] Vice Admiral Dennis Blair, Statement to the House Armed Services Committee, Military Procurement and Military Research & Development Subcommittees, 9 April 1997, available from http://www.fas.org/irp/congress/1997_hr/h970409b.htm; Internet; accessed 8 Dec 2005.

[73] Government Accounting Office, *Force Structure: Improved Strategic Planning Can Enhance DOD's Unmanned Aerial Vehicles Efforts,* March 2004, 13.

[74] Ibid.

[75] Ibid.

[76] Defense Industry Daily, *Two New U.S. Organizations to Optimize UAVs*, 13 July 2005; available at http://www.defenseindustrydaily.com/2005/07/two-new-us-organizations-to-optimize-uavs/index.php; Internet, accessed 17 December 2005.

[77] Geoff Fein, Marines Seeing Benefits of UAVs and Network Centric Operations, *C4I News,* Aug 4, 2005. pg. 1, available from http://www.defensedaily.com/...mmon/ pub/c4i/c4i04140503.html; Internet, accessed 13 December 2005.

[78] Ibid.

[79] Ibid.

[80] Ibid.

[81] Rebecca Grant, "The Clash of the UAV Tribes", *Air Force Magazine*, September 2005, 49.

[82] U.S. Department of Defense, *Joint Doctrine for Airspace Control in the Combat Zone*, Joint Publication 3-52, (Washington D.C.: Office of the Joint Chiefs of Staff, 30 August 2004), I-4.

[83] *Unmanned Aircraft Systems Roadmap 2005 – 2030,* 45.

[84] Ibid.

[85] Sandra I. Erwin, UAV Programs Need Common Standards, *National Defense Magazine* October 2003, 16.

[86] *Unmanned Aircraft Systems Roadmap 2005 – 2030,* 43.

[87] LaMartin, 6.

[88] LaMartin, 6.